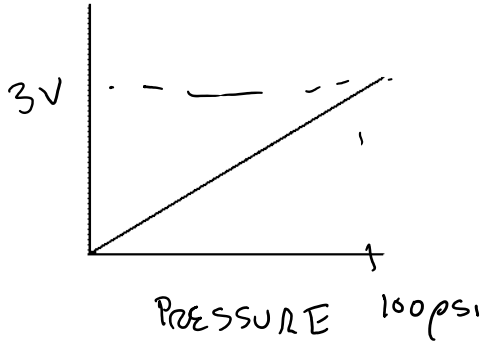
Lecture 22 - Analog to Digital Conversion

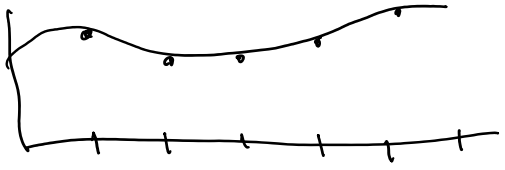
Wednesday, April 22, 2020 2:37 PM

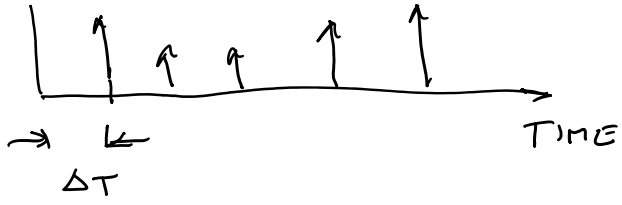


SAMPLE

1024 POSSIBLE VALUES

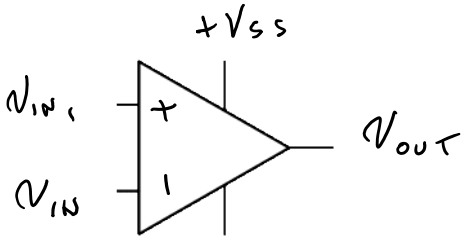
$\frac{100}{1024} = 0.097$ psi/bit





ISSUES W/SAMPLING

1. QUANTIZATION
2. SAMPLING RATE
3. JITTER
4. ALIASING



OP AMP COMPARATOR

$V_{IN_1} > V_{IN_2}$ $V_{OUT} = +V_{SS}$

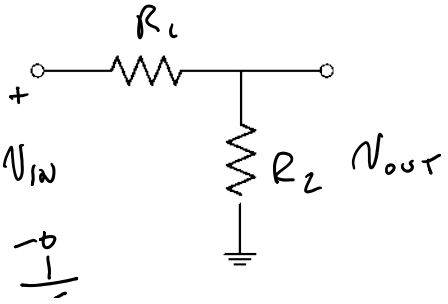
$V_{IN_2} > V_{IN_1}$ $V_{OUT} = -V_{SS}$

OP AMPS

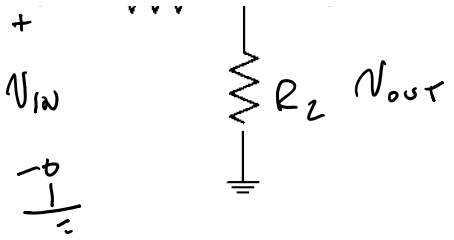
$Z_{IN} = \infty$

$Z_{OUT} = 0$

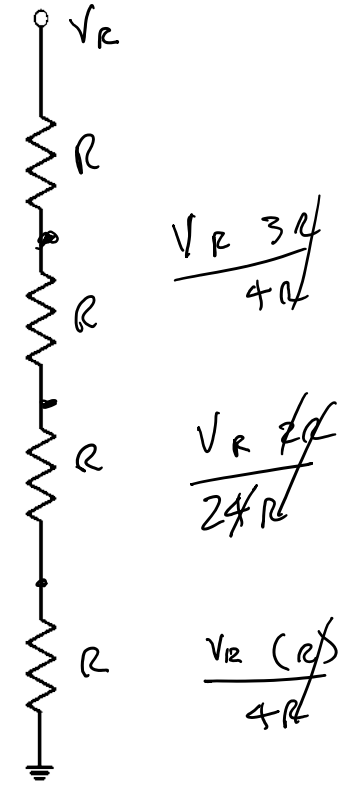
$A_V = \infty$



$$V_{OUT} = \frac{V_{IN} R_2}{R_1 + R_2}$$

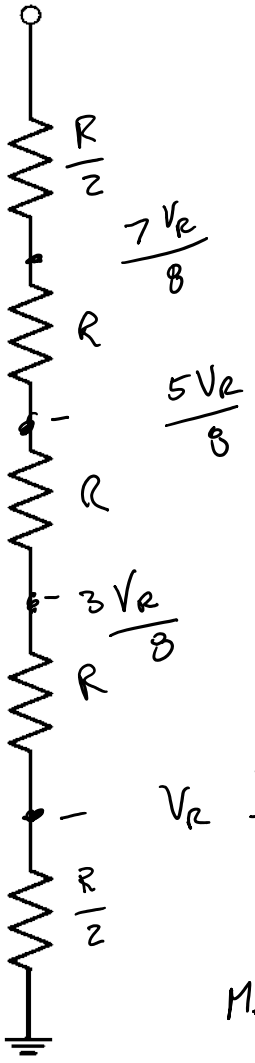


$$V_{out} = \frac{V_{IN} R_2}{R_1 + R_2}$$



MAX ERROR

$\frac{V_R}{4} \cdot \epsilon$



$V_R \frac{R}{2} \cdot \frac{1}{4R} = \frac{V_R}{8}$

MAX ERROR $\frac{V_R}{8} - \epsilon$

3bit Flash ADC

DIRECT CONVERSION OR "FLASH" ADC

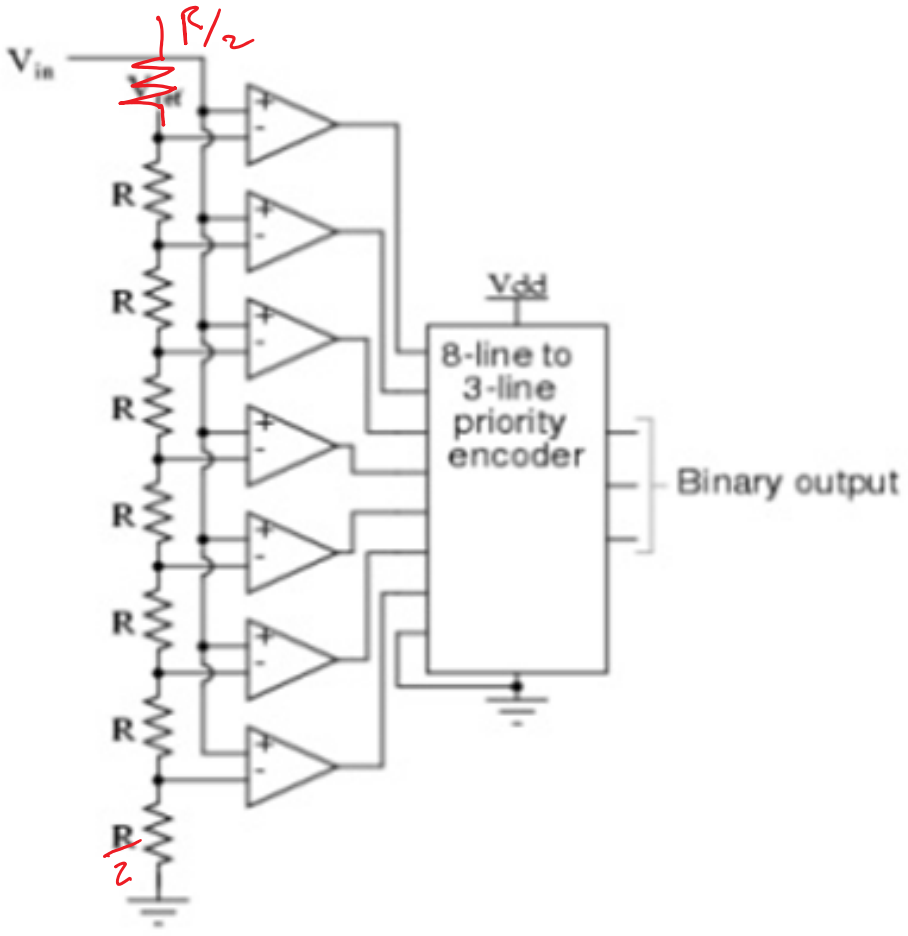
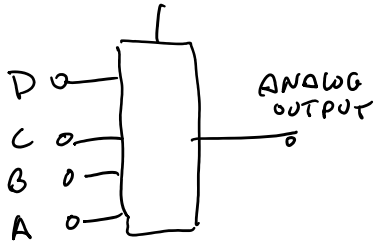


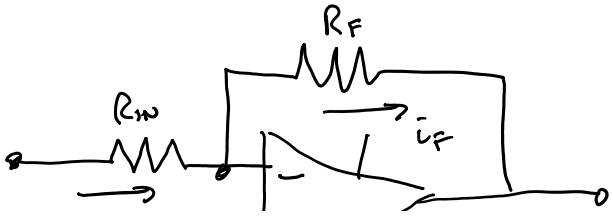
Fig 1.2 Block Diagram of Flash ADC [17]

DIGITAL TO ANALOG CONVERTER

LET $V_{REF} = 15V$

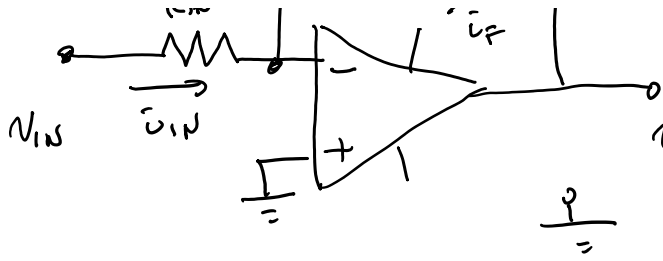


D C B A	V_{OUT}
0 0 0 0	0
0 0 0 1	1V
0 0 1 0	2V
0 0 1 1	3V
⋮	⋮
1 1 1 1	15V



$Z_{IN} = \infty$

$i_{IN} = \frac{V_{IN}}{R_{IN}}$



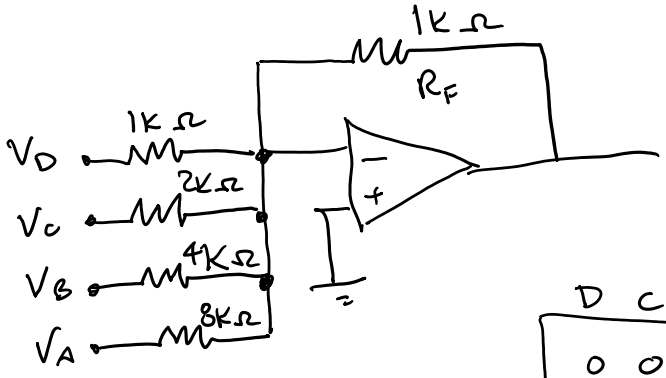
$$i_{IN} = \frac{V_{IN}}{R_{IN}}$$

$$i_F = -\frac{V_o}{R_F}$$

$$i_{IN} = i_F$$

$$\frac{V_{IN}}{R_{IN}} = -\frac{V_{OUT}}{R_F}$$

$$Gain = \frac{V_{OUT}}{V_{IN}} = \frac{-R_F}{R_{IN}}$$



V_x = 0 or 5V

D C B A	V_{OUT}
0 0 0 0	0
0 0 0 1	-.62V
0 0 1 0	-1.25
0 0 1 1	-1.875
⋮	⋮
1 1 1 1	-9.375

SUCCESSIVE APPROXIMATION

① COUNTING - REGISTER COUNTS FROM ZERO UNTIL OP AMP COMPARATOR OUTPUT GOES FROM HIGH TO LOW

** VARIABLE CONVERSION TIME

② BIT-WISE - START WITH MSB AND WORK TOWARDS LSB
CONSTANT CONVERSION TIME.

REAL-LIFE SIGNALS CHANGE WITH TIME

WE NEED TO KEEP V_{IN} DURING THE CONVERSION PROCESS

WE MAKE A COPY OF THE SIGNAL

WE MAKE A COPY OF THE SIGNAL

ADC Conceptual Configuration